IN THE CLAIMS

This listing of the claim will replace all prior versions and listings of claim in the present application.

Listing of Claims

1. (currently amended) An automatic frequency control signal generating circuit comprising:

a first frequency error detection unit for extracting from an input signal at least two known different symbols as a first symbol set, detecting a first frequency error of said input signal based on said extracted first symbol set, and delivering said first frequency error;

a second frequency error detection unit for extracting from said input signal at least two known symbols having a symbol distance different from that of said first symbol set as a second symbol set, detecting a second frequency error of said input signal based on said extracted second symbol set and delivering said second frequency error;

a decision unit for deciding which one of ~~outputs~~ the first and second frequency errors of said first and second frequency error detection units is selected; and

a control signal unit for generating a control signal adapted to control the frequency of said input signal based on ~~an output of one~~said one of the first and second frequency errors of said first ~~or~~ and second frequency error detection units selected by said decision unit.

2. (currently amended) An automatic frequency control signal generating circuit according to claim 1, wherein said control signal unit includes:

a positive/negative decision unit for deciding whether the ~~output~~ first or second frequency errors of ~~one of said first and~~said first or second frequency error detection units selected by said decision unit is a positive value or a negative value and delivering a result of a decision by said position/negative decision unit; and

an accumulating unit for accumulating ~~a value~~the result delivered out of said positive/negative decision unit and delivering an integrated signal as said control signal.

3. (currently amended) An automatic frequency control signal generating circuit according to claim 2, wherein said decision unit compares a predetermined reference value with an absolute value of the output of said first frequency error detection unit and effects detection of ~~an output~~the first or the second frequency errors of one of said first ~~and~~ or second frequency error ~~detection~~ selection units in accordance with a comparison result.

4. (previously presented) An automatic frequency control signal generating circuit according to claim 3, wherein a frame format of said input signal includes a known pilot signal, a data area of predetermined symbol length and a known synchronous word symbol area of predetermined symbol length,

wherein said first frequency error detection unit extracts at least two synchronous word symbols in said synchronous word symbol area, and said second frequency error detection unit extracts said pilot signal and a synchronous word symbol in said synchronous word symbol area.

5. (currently amended) An automatic frequency control signal generating circuit according to claim 1, wherein said first frequency error detection unit includes:

a first multiplier for calculating and delivering a product of one symbol of said first symbol set and a complex conjugate of said symbol;

a first complex conjugate unit for ~~inverting and conducting a complex conjugate of said symbol, and delivering~~generating and outputting a phase of the product delivered ~~out of~~by said first multiplier,

a second multiplier for calculating and delivering a product of another symbol of said first symbol set and a complex conjugate of said another symbol,

a third multiplier for performing complex multiplication of the output of said ~~phase inverter~~first complex conjugate circuit and the product delivered ~~out of~~by said second multiplier and delivering a complex first product, and

a first phase detection unit for detecting the phase of the output of said third multiplier and delivering said detected phase as said first frequency error and

wherein said second frequency error detection unit includes:

a fourth multiplier for calculating and delivering a product of one symbol of said second symbol set and a complex conjugate of said symbol of the second symbol set,

a second complex conjugate unit for ~~inverting and conducting a complex conjugate of said symbol, and delivering~~generating and outputting a phase of the product delivered ~~out of~~by said fourth multiplier,

a fifth complex multiplier for calculating and delivering a product of another symbol of said second symbol set and a complex conjugate of said another symbol of said second symbol set,

a sixth multiplier for performing complex multiplication of the output of said ~~phase inverter~~second complex conjugate and the product delivered ~~out of~~by said fifth complex multiplier and delivering a second complex product, and

a second phase detection unit for detecting the phase of the output of said sixth complex multiplier and delivering said detected phase as said second frequency error.

6. (previously presented) An automatic frequency control signal generating circuit according to claim 5, wherein one symbol of said first symbol set input to said first multiplier and another symbol of said first symbol set input to said second multiplier are located at positions which are distant from each other by n symbols in said input signal, where n is a power of 2.

7. (previously presented) An automatic frequency control signal generating circuit according to claim 5, wherein a frame format of said input

signal includes a data area of predetermined symbol length and a known synchronous word symbol area of predetermined symbol length, one symbol of said first symbol set inputted to said first multiplier is an initial synchronous word symbol of said synchronous word symbol area, another symbol of said first symbol set inputted to said second multiplier is one synchronous word symbol selected from a second and ensuing synchronous word symbols of said synchronous word symbol area, and said first frequency error detection unit further includes a switch unit for selecting and delivering one desired synchronous word symbol from the second and ensuing synchronous word symbols of said synchronous word symbol area of said input signal.

8. (previously presented) An automatic frequency control signal generating circuit according to claim 7, wherein one symbol to be selected from the second and ensuing synchronous word symbols by means of said switch unit is located at a position which is distant from said initial synchronous word symbol by n symbols, where n is a power of 2.

9. (previously presented) An apparatus for receiving signals having the automatic frequency control signal generating circuit as recited in claim 1, further comprising:

an RF receiving circuit for performing frequency conversion of a received signal, converting the received signal subjected to the frequency conversion into a digital signal and delivering it;

an oscillator for delivering to said RF receiving circuit a reference frequency signal for the frequency conversion;

a quadrature detector for converting the received signal subjected to the digital conversion into a baseband signal and delivering it;

a filter for eliminating unwanted frequency components of the received baseband signal and delivering a resulting signal;

a frequency corrector for correcting an error between the frequency of the baseband signal delivered out of said filter and the frequency of said reference frequency signal on the basis of said control signal from said automatic frequency control signal generating circuit and delivering a corrected baseband signal;

a demodulator for demodulating and delivering the baseband signal received from said frequency corrector; and

a buffer for holding the corrected baseband signal output of said frequency corrector,

wherein said automatic frequency control signal generating circuit extracts said first and second symbol sets from said input signal now represented by the corrected baseband signal held in said buffer and generates said control signal on the basis of said symbol sets to supply said control signal to said frequency corrector.

10. (previously presented) A radio base station apparatus comprising:

the receiving apparatus as recited in claim 9, further comprising:

a radio transmitting circuit for converting a signal of baseband zone to be transmitted, which signal is converted to an analog signal, into a signal of

radio frequency band based on the reference frequency signal of said oscillator.

11. (previously presented) A radio transmitting/receiving system comprising:

the radio base station as recited in claim 10, further comprising:

at least one mobile radio transmitting/receiving apparatus,

wherein said at least one mobile radio transmitting/receiving apparatus receives a transmitting signal from said radio base station and controls a reference frequency signal inside said mobile radio transmitting/receiving apparatus based on a reference frequency signal extracted from said received signal.

12. (previously presented) An apparatus for receiving signals having the automatic frequency control signal generating circuit as recited in claim 1, further comprising:

an RF receiving circuit for performing frequency conversion of a received signal, converting the received signal subjected to the frequency conversion into a digital signal and delivering the received signal;

an oscillator for delivering to said RF receiving circuit a reference frequency signal for the frequency conversion;

a quadrature detector for converting the received signal subjected to digital conversion into a baseband signal and delivering it;

a filter for eliminating unwanted frequency components from the received baseband signal and delivering a resulting signal;

a demodulator for demodulating and delivering the baseband signal received from said filter; and

a buffer for holding the output of said filter,

wherein said automatic frequency control signal generating circuit extracts said first and second symbol sets from said input signal now represented by the signal held in said buffer and generates said control signal based on said symbol sets, and said receiving apparatus further includes a frequency controller for controlling said reference frequency signal of said oscillator based on said control signal from said automatic frequency control signal generating circuit.

13. (previously presented) A radio terminal apparatus comprising:

the receiving apparatus as recited in claim 12, further comprising:

a radio transmitting circuit for converting a signal of baseband zone to be transmitted, which signal is converted into an analog signal, into a signal of radio frequency band based on the reference frequency signal of said oscillator.

14. (currently amended) A frequency error detection method comprising the steps of:

a) extracting at least two known different symbols as a first symbol set from an input signal;

b) calculating and delivering a product of one symbol of said first symbol set and a complex conjugate of said symbol;

c) ~~inverting and delivering the phase of the output in said step b)~~generating and delivering a phase of the product calculated in said step b);

d) calculating and delivering a second product of another symbol of said first symbol set and a complex conjugate of said another symbol of said first symbol set;

e) performing complex multiplication of the ~~outputs in said steps c) and d)~~phase of the product calculated in step c) and the second product calculated in step d) and delivering a third product; and

f) detecting the phase of the ~~output~~ third product calculated in ~~said~~ step e) and delivering said detected phase as a first frequency error of said input signal.

15. (previously presented) A frequency error detection method according to claim 14, wherein one symbol of said first symbol set in said step b) and another symbol in said first symbol set in said step d) are located at positions which are distant from each other by n symbols inside said input signal, where n is a power of 2.

16. (currently amended) A frequency error detection method according to claim 14, wherein when a frame format of said input signal includes a data area of predetermined symbol length and a known synchronous word symbol area of predetermined symbol length, one symbol of said first symbol set in said step b) is ~~a~~ an initial synchronous word symbol of said synchronous word symbol area and another symbol of said first symbol set in said step d) is one synchronous word symbol desirably selected

from the second and ensuing synchronous word symbols of said synchronous word symbol area.

17. (currently amended) A frequency error detection method according to claim 14 further comprising the steps of:

g) extracting, as a second symbol set, at least two known symbols having a different symbol distance from that in said first symbol set from said input signal;

h) calculating and delivering a fourth product of one symbol of said second symbol set and a complex conjugate of said symbol of said second symbol set;

i) ~~inverting~~ generating and delivering ~~the phase of the value~~a phase of the fourth product delivered in said step h);

j) calculating and delivering a fifth product of another symbol of said second symbol set and a complex conjugate of said symbol of said second symbol set;

k) performing complex multiplication of ~~the outputs in said steps i) and j)~~the phase of the fourth product and the fifth product and delivering a sixth product;

l) detecting ~~the~~ a phase of ~~the output~~sixth product calculated in said step k) and delivering said detected phase as a second frequency error of said input signal; and

m) selecting any one of said first and second frequency errors on the basis of a predetermined condition.

18. (original) A frequency error detection method according to claim 17, wherein when said first frequency error is $\phi 1$, said second frequency error is $\phi 2$ and a positive reference value preset desirably is ϕth, said step m) further includes a step of selecting said second frequency error $\phi 2$ if an absolute value $|\phi 1|$ of said first frequency error $\phi 1$ satisfies $|\phi 1| < \phi th$ but selecting said first frequency error $\phi 1$ if $|\phi 1|$ satisfies $|\phi 1| > \phi th$.

19. (currently amended) A method for receiving signals having the steps a) to m) as recited in claim 18, further comprising the steps of:

n) performing frequency conversion of a received signal, converting the received signal subjected to the frequency conversion into a digital signal and delivering it;

o) delivering a reference frequency signal for said frequency conversion in said step n);

p) a step of converting the received signal subjected to digital conversion into a baseband signal, applying quadrature detection on the converted baseband signal, and then outputting the detected baseband signal ~~to cause it to be applied with quadrture detection and then delivered~~;

q) eliminating unwanted frequency components from the delivered baseband signal;

r) correcting an error between the frequency of the baseband signal delivered in said step q) and the frequency of said reference frequency signal based on the frequency error signal delivered in said step m) and delivering a corrected baseband signal;

s) demodulating and delivering the output of the corrected baseband signal in said step r); and

t) holding the output in said step s),

wherein the extraction of said first and second symbol sets in said steps a) and g) is carried out from the signal held in said step t).

20. (previously presented) A method for transmitting and receiving signals having the steps a) to t) as recited in claim 19, further comprising the step of:

converting a signal of baseband zone to be transmitted, which signal is converted into an analog signal, into a signal of radio frequency band on the basis of said reference frequency signal and transmitting the converted radio frequency band signal.

21. (currently amended) An automatic frequency control signal generating circuit comprising:

a frequency error detection unit for extracting at least two known different symbols as a first symbol set from an input signal, further extracting, as a second symbol set, at least two known symbols having a different symbol distance from that of said first symbol set from said input signal, detecting first and second frequency errors of said input signal based on said extracted first and second symbol sets and delivering them;

a decision unit for deciding ~~in accordance with values~~as to which one of said first and second frequency errors is selected in accordance with values of said first and second frequency errors; and

a control signal unit for generating a control signal adapted to control the frequency of said input signal based on the first or second frequency error selected by said decision unit.

22. (currently amended)An automatic frequency control signal generating circuit according to claim 21, wherein when a frame format of said input signal includes a known pilot signal, a data area of predetermined symbol length and a known synchronous word symbol area of predetermined symbol length, said first symbol set includes said pilot signal and one synchronous word symbol in the synchronous word symbol area and said second symbol set includes two synchronous word symbols in said synchronous word symbol area, wherein said frequency error detection unit further includes:

a switch unit for selecting and delivering any one of the pilot signal or one synchronous word symbol of said synchronous word symbol area in one frame of said input signal;

a first multiplier for calculating and delivering a first product of the symbol delivered ~~out of~~by said switch unit and a complex conjugate of said symbol;

a ~~phase inversion~~complex conjugate unit for ~~inverting~~ generating and delivering ~~the~~ a phase of the ~~value~~ first product delivered out of said first multiplier;

a second multiplier for calculating and delivering a second product of another synchronous word symbol of said synchronous word symbol area and

a complex conjugate of said ~~symbol~~another synchronous word symbol of said synchronous of said synchronous word symbol area;

a third multiplier for performing complex multiplication of the ~~output of said phase inversion~~phase generated by said complex conjugate unit and the ~~output of~~second product calculated by said second multiplier and delivering a ~~complex~~ third product; and

a phase detection unit for detecting ~~the~~ a phase of the ~~output of~~third product calculated by said third multiplier and delivering the detected phase as said first or second frequency error, and

wherein the phase detected by said phase detection unit when said switch selects said pilot signal is made to be said first frequency error and the phase detected by said phase detection unit when said switch unit selects one synchronous word symbol of said synchronous word symbol area is made to be said second frequency error.